

Workshop on Molecular Evolution
July 27-August 8, 2003
(Extended Special Topics Session
August 8-August 15, 2003)

Course Director: Michael P. Cummings, University of Maryland and Marine Biological Laboratory

Molecular evolution has become the nexus of many areas of biological research. It both brings together and enriches such areas as biochemistry, molecular biology, microbiology, population genetics, systematics, developmental biology, genomics, bioinformatics, in vitro evolution, and molecular ecology. The Workshop provides an important contribution to these fields in that it promotes interdisciplinary research and interaction, and thus provides a glue that sticks together disparate fields. Due to the wide range of fields addressed by the study of molecular evolution, it is difficult to offer a comprehensive course in a university setting. It is rare for a single institution to maintain expertise in all necessary areas. In contrast, the Workshop is uniquely able to provide necessary breadth and depth by utilizing a large number of faculty with appropriate expertise. Furthermore, the flexible nature of the Workshop allows for rapid adaptation to changes in the dynamic field of molecular evolution. For example, the 2003 Workshop included recently emergent research areas of molecular evolution of development and genomics.

The interest in the Workshop remains very strong and is increasing. The number of applications for the 2003 course was 143, continuing the trend of increased applications since 2000. In 2003 there were 60 students participating in the Workshop, which was taught by 19 faculty and 4 teaching assistants. The students came from all over the world (17 countries), and represented several career stages: graduate students (57%), postdoctoral researchers (13%), faculty/principal investigators (27%), and other (3%). For the years 2000 – 2003, the students came from more than 164 different institutions.

The subjects covered in the Workshop included the following -

1. Databases and sequence matching: database searching: protein sequence versus protein structure; homology; mathematical, statistical, and theoretical aspects of sequence database searches.
2. Phylogenetic analysis: theoretical, mathematical and statistical bases; sampling properties of sequence data; Bayesian analysis; hypothesis testing.
3. Maximum likelihood theory and practice in phylogenetics and population genetics: coalescent theory; maximum likelihood estimation of population genetic parameters.
4. Molecular evolution integrated at organism and higher levels: population biology; biogeography; ecology; systematics and conservation.

5. Molecular evolution and development: gene duplication and divergence; gene family organization; coordinated expression in evolution.
6. Applied molecular evolution: molecular evolution in bioinformatics; evolution of large multigene families.
7. Comparative genomics: genome content; genome structure; genome evolution.
8. Transposable elements: types; history; evolutionary dynamics; as a major component of genomes.
9. Molecular evolution integrated at different levels II: biochemistry; cell biology; physiology; relationship of genotype to phenotype.

Formal instruction consisting of lectures, software demonstrations and computer work was scheduled over a 13 hour period each day during the two week period. The extended topics session provided essentially unlimited access to Workshop resources over a one week period. Twelve students participated in the extended topics session.

For 2003 the Workshop Web site was rebuilt from scratch and implemented a simpler design and some expanded content. The web site serves four primary purposes -

1. Prepare students in advance of their participation in the Workshop. All Workshop participants are strongly encouraged to make use of the web site as part of their preparations for attending the course. In this way each participant is made aware of the details of the Workshop schedule, expectations, and provided with resources to help prepare them in the best ways possible at their convenience. There is a web page with detailed information on preparing prior to the start of the Workshop.
2. Assist students while in attendance at the Workshop. Students have opportunities to review lecture notes and graphics, and follow-up on lecture and lab presentations through rapid access to relevant materials. The web site provides an extensive reference list, glossary and pages devoted to software used in the Workshop.
3. Provide a means to maintain and increase learning after participating in the Workshop. Although the attendance at the Workshop is only two or three weeks in length, the ability for a participant to refresh their knowledge by review of course materials continues well after they depart Woods Hole. In this way the students can use the Workshop as a continuing source of learning about molecular evolution.
4. Provide a resource for those who do not attend the Workshop. For a variety of reasons not everyone who is interested in doing so can attend the Workshop. The web site serves these people by providing an integrated resource through which they can learn more about molecular evolution. Many participants in past Workshops share their notes, handouts, and recollections from their experience with their colleagues. One motivation

for the web site is to increase the value and reach of the Workshop by leveraging its assets by providing a definitive source of material. The Workshop web site has been quite successful, having received over 2.4 million requests for pages in the first 36 months of operation. The web site has been accessed from over 90,000 different computers from all over the United States and many other countries (primarily Europe and Japan). The web site will continue to be updated and expanded in future years.

Partial funding support for the Workshop comes from the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA). Some software was generously provided by Accelrys.

Table 1 – Diversity of Students Participating in the Workshop on Molecular Evolution

Year	# of Students	Female Students	Minority Students	Foreign Students*
2003	60	29	0	32
2002	63	24	1	29
2001	60	29	2	30
2000	61	23	1	31

*These students for the years 2000 – 2003 represented 38 different countries.

Table 2: 2000 – 2003 Molecular Evolution Course Faculty

2003

Course Director

Michael Cummings *University of Maryland*

Faculty

Peter Beerli	<i>University of Washington</i>
Scott Edwards	<i>University of Washington</i>
Jonathan Eisen	<i>TIGR</i>
Joseph Felsenstein	<i>University of Washington</i>
Mary Kuhner	<i>University of Washington</i>
Axel Meyer	<i>University of Konstanz</i>
Michael Miyamoto	<i>University of Florida</i>
Daniel Myers	<i>Pomona College</i>
William Pearson	<i>University of Virginia</i>

David Rand	<i>Brown University</i>
David Swofford	<i>Florida State University</i>
Steve Thompson	<i>Florida State University</i>
Paul Turner	<i>Yale University</i>
Ziheng Yang	<i>University College London</i>
Anne Yoder	<i>Yale University</i>

Lecturers

Mark Holder	<i>University of Connecticut</i>
William Pearson	<i>University of Virginia</i>
Margaret Riley	<i>Yale University</i>
Daniel Voytas	<i>Iowa State University</i>

Teaching Assistants

Matthew Dean	<i>University of Iowa</i>
Johanna Fehling	<i>Scottish Assoc for Marine Sci</i>
Scott Handley	<i>Washington University</i>
David Kysela	<i>Yale University</i>

2002

Course Director

Michael Cummings	<i>Marine Biological Laboratory</i>
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Faculty

Scott Edwards	<i>University of Washington</i>
Jonathan Eisen	<i>The Institute for Genomic Research</i>
David Swofford	<i>Florida State University</i>
Peter Beerli	<i>University of Washington</i>
Joseph Felsenstein	<i>University of Washington</i>
Mary Kuhner	<i>University of Washington</i>
Paul Lewis	<i>University of Connecticut</i>
Axel Meyer	<i>University of Konstanz</i>
David Rand	<i>Brown University</i>
Steven Thompson	<i>Florida State University</i>
Ziheng Yang	<i>University College London</i>
Anne Yoder	<i>Yale University</i>

Lecturers

Claire Fraser	<i>The Inst. for Genomic Research</i>
William Pearson	<i>U. of Virginia</i>
Michael Sanderson	<i>UC Davis</i>
Daniel Voytas	<i>Iowa State University</i>
Shozo Yokoyama	<i>Syracuse University</i>

Teaching Assistants

Antonis Rokas	<i>University of Wisconsin-Madison</i>
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Rauri C.K. Bowie
Louise Mead
Katarina Winka

University of Cape Town
Oregon State University
Umeå University

2001

Director

Michael Cummings

Marine Biological Laboratory

Faculty

Peter Beerli
Scott Edwards
Jonathan Eisen
Joseph Felsenstein
Claire M. Fraser
Mary Kuhner
Paul O. Lewis
Emilia Martins
Axel Meyer
William Pearson
David Rand
Ken Rice
David Swofford
Steven Thompson
Daniel F. Voytas
Ziheng Yang
Anne D. Yoder
Shozo Yokoyama

University of Washington
University of Washington
Institute for Genomic Research
University of Washington
Institute for Genomic Research
University of Washington
University of Connecticut
University of Oregon
University of Konstanz, Germany
University of Virginia Health Sciences Center
Brown University
GlaxoSmithKline Pharmaceuticals
Smithsonian Institution
BioInfo 4U
Iowa State University
University College London
Northwestern University Medical School
Syracuse University

Teaching Assistants

Josephine Babin
Sheri A. Church
Scott Handley
Andrew McArthur
Ellen Pritham
David Reed
Antonis Rokas
Julie Thompson-Maaloum
Katarina Winka

Louisiana State University
University of Virginia
Washington University
Marine Biological Laboratory
University of Massachusetts
University of Utah
University of Edinburgh
Inst. de Genetique et de Biol. Moleculaire et Cellulaire
Umea University

2000

Course Director

Michael Cummings

Marine Biological Laboratory

Faculty

Peter Beerli
Scott Edwards

University of Washington
University of Washington

Jonathan Eisen	<i>Institute for Genomic Research</i>
Joseph Felsenstein	<i>University of Washington</i>
Claire M. Fraser	<i>Institute for Genomic Research</i>
John P. Huelsenbeck	<i>University of Rochester</i>
Mary Kuhner	<i>University of Washington</i>
Paul O. Lewis	<i>University of Connecticut</i>
Wayne P. Maddison	<i>University of Arizona</i>
Axel Meyer	<i>University of Konstanz, Germany</i>
Nipam Patel	<i>University of Chicago</i>
William Pearson	<i>University of Virginia Health Sciences Center</i>
David Rand	<i>Brown University</i>
Ken Rice	<i>Bioinformatics</i>
Margaret A. Riley	<i>Yale University</i>
David Swofford	<i>Smithsonian Institution</i>
Steven Thompson	<i>BioInfo 4U</i>
Daniel F. Voytas	<i>Iowa State University</i>
Anne D. Yoder	<i>Northwestern University Medical School</i>
Shozo Yokoyama	<i>Syracuse University</i>

Teaching Assistants

Linda Amaral-Zettler	<i>Marine Biological Laboratory</i>
Josephine Babin	<i>Louisiana State University</i>
Sheri A. Church	<i>University of Virginia</i>
Paige M. Dennis	<i>University of Massachusetts</i>
Ben FrantzDale	
Andrew McArthur	<i>Marine Biological Laboratory</i>
Monica Medina	<i>Marine Biological Laboratory</i>
Ellen Pritham	<i>University of Massachusetts</i>
David Reed	<i>Louisiana State University</i>
Molly E. Waring	<i>Marine Biological Laboratory</i>